

SEQUENCE LISTING

<110> COSTA E SILVA, OSWALDO DA
 VAN THIELEN, NOCHA
 CHEN, ROUYING
 ISHITANI, MANABU

<120> PHOSPHATASE STRESS-RELATED PROTEINS AND METHODS OF USE
 IN PLANTS

<130> 16313-0029

<140> 09/828,302

<141> 2001-04-06

<150> 60/196,001

<151> 2000-04-07

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<170> PatentIn Ver. 2.1

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Ala Ala Gly Ser Thr Pro Pro Leu Pro Pro Arg Ser Ser Gly Ser Pro
      115              120              125

Met Ser Pro Arg Ser Pro Phe Ser Arg Arg Met Gly Thr Ser His Leu
      130              135              140

Met Arg Asp Ser Pro Leu Lys Lys Ser Ser Glu Pro Val Arg Glu Ile
      145              150              155              160

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Ile Pro Gln Phe Tyr Phe Pro Asn Gly Pro Pro Pro Ser Lys Asp Thr
 165 170 175
 Ile Glu Ser Cys Met Ala Arg Val Asn Gln Ile Phe Gly Ala His Pro
 180 185 190
 Glu Gly Leu Pro Ala Ser Ala Phe Ala Thr Ile Thr Lys Asp Val Cys
 195 200 205
 Lys Leu Pro Ser Phe Phe Ser Met Ala Leu Phe Lys Lys Ile Asp Ile
 210 215 220
 Asn Asn Thr Gly Leu Val Thr Arg Asp Lys Phe Val Glu Tyr Trp Val
 225 230 235 240
 Asp Gln Asn Met Leu Ala Met Asp Thr Ala Thr Arg Val Phe Thr Val
 245 250 255
 Leu Lys Gln Pro Asp Lys Asn Phe Leu Arg Gln Glu Asp Phe Arg Pro
 260 265 270
 Val Leu Arg Glu Leu Leu Leu Thr His Arg Gly Leu Glu Phe Leu His
 275 280 285
 Asp Thr Pro Glu Phe Gln Asp Arg Tyr Ala Glu Thr Val Ile Tyr Arg
 290 295 300
 Ile Phe Tyr His Val Asn Arg Ala Gly Asn Gly Arg Leu Gln Leu Arg
 305 310 315 320
 Glu Leu Lys Arg Ser Asn Leu Ile Ala Ala Leu Gln Gln Val Asp Glu
 325 330 335
 Glu Glu Asp Ile Asn Lys Val Leu Arg Tyr Phe Ser Tyr Glu His Phe
 340 345 350
 Tyr Val Ile Tyr Cys Lys Phe Trp Glu Leu Asp Ser Asp His Asp Phe
 355 360 365
 Leu Ile Asp Lys Asp Asp Leu Leu Arg Tyr Gly Asn His Ala Leu Thr
 370 375 380
 Tyr Arg Ile Val Glu Arg Ile Phe Ser Gln Val Pro Arg Lys Phe Thr
 385 390 395 400
 Ser Lys Val Ala Gly Lys Met Gly Tyr Glu Asp Phe Val Trp Phe Ile
 405 410 415
 Leu Ser Glu Glu Asp Lys Ser Ser Glu Pro Ser Leu Glu Tyr Trp Phe
 420 425 430
 Lys Cys Val Asp Leu Asp Cys Asp Gly Met Ile Ile Leu Asn Glu Met
 435 440 445
 Gln Tyr Phe Tyr Glu Glu Gln Leu His Arg Met Glu Cys Met Ala Gln
 450 455 460

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Glu Pro Val Leu Phe Glu Asp Ile Val Cys Gln Met Thr Asp Met Ile
465 470 475 480

Gly Pro Ala Asn Glu Gly Arg Leu Thr Leu Arg Asp Leu Lys Arg Cys
485 490 495

Lys Leu Ser Gly Asn Phe Phe Asn Ile Leu Phe Asn Leu Asn Lys Phe
500 505 510

Val Ala Phe Glu Thr Arg Asp Pro Phe Leu Ile Arg Gln Glu Arg Glu
515 520 525

Asp Pro Ser Leu Thr Glu Trp Asp Arg Phe Ala His Ile Glu Tyr Ile
530 535 540

Arg Leu Ser Met Glu Glu Asp Gly Glu Asp Ala Ser Asn Gly Ser Ala
545 550 555 560

Glu Val Trp Asp Glu Pro Gly Tyr Glu Ala Pro Phe
565 570

<210> 12

<211> 532

<212> PRT

<213> Physcomitrella patens

<400> 12

Met Ile Ser Gly Ala Ser Gly Ala Pro Ala Gly Ala Pro Val Pro Thr
1 5 10 15

Ala Thr Gly Ser Val Ala Ala Pro Leu Pro Ala Leu Glu Trp Lys Phe
20 25 30

Ser Gln Val Phe Gly Glu Arg Ala Ile Gly Glu Glu Val Gln Glu Val
35 40 45

Asp Ile Ile Ser Ala Ile Glu Phe Asp Lys Thr Gly Glu His Leu Ala
50 55 60

Thr Gly Asp Arg Gly Gly Arg Val Val Leu Phe Glu Arg Thr Asp Gly
65 70 75 80

Lys Asp Gln Arg Thr Arg Arg Glu Leu Glu Arg Ala Asp Ser Ala Gly
85 90 95

Ser Arg His Pro Glu Tyr Arg Tyr Ser Thr Glu Phe Gln Ser His Glu
100 105 110

Pro Glu Phe Asp Tyr Leu Lys Ser Leu Glu Ile Glu Glu Lys Ile Asn
115 120 125

Lys Ile Arg Trp Cys Gln Thr Ala Asn Ala Ala Gln Phe Leu Ile Ser
130 135 140

Thr Asn Asp Lys Thr Ile Lys Leu Trp Lys Val Thr Glu Lys Lys Val
145 150 155 160

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Lys Gln Val Lys Asn Leu Asn Val Asp Pro Gly Ala Arg Gly Asn Gly
 165 170 175
 Asn Pro Leu Ser Asn Asn Met Met Leu Asn Pro Lys Gly Phe Ala Pro
 180 185 190
 Arg Leu Ser Met Asn Gly Val Ala Ala Asn Arg Ser Thr Pro Ala Ile
 195 200 205
 Ser Pro Asp Phe Val Phe Pro Pro Gly Gly Ile Pro Ser Leu His Leu
 210 215 220
 Pro Ser Val Trp Ser Asn Glu Thr Ala Leu Val Ala Arg Cys Arg Arg
 225 230 235 240
 Ala Tyr Ala Asn Ala His Ala Tyr His Ile Asn Ser Ile Ser Asn Asn
 245 250 255
 Ser Asp Cys Glu Thr Tyr Ile Ser Ala Asp Asp Leu Arg Ile Asn Leu
 260 265 270
 Trp Asn Leu Glu Val Ser Asp Gln Ser Phe Asn Ile Val Asp Ile Lys
 275 280 285
 Pro Thr Asn Met Glu Asp Leu Thr Glu Val Ile Thr Ser Ala Glu Phe
 290 295 300
 His Pro Ser His Cys Asn Val Leu Ala Tyr Ser Ser Ser Lys Gly Ser
 305 310 315 320
 Ile Arg Leu Ile Asp Met Arg Gln Ser Ala Leu Cys Asp Arg His Ser
 325 330 335
 Lys Leu Phe Glu Glu Thr Glu His Ala Gly Ser Arg Ser Phe Phe Thr
 340 345 350
 Glu Ile Ile Ala Ser Ile Ser Asp Ile Lys Phe Ala Arg Gly Gly Arg
 355 360 365
 Tyr Ile Leu Ser Arg Asp Tyr Met Thr Leu Lys Leu Trp Asp Val Asn
 370 375 380
 Met Glu Ser Ser Pro Val Ala Val Phe Lys Val His Glu Tyr Leu Arg
 385 390 395 400
 Pro Lys Leu Cys Asp Leu Tyr Glu Asn Asp Ser Ile Phe Asp Lys Phe
 405 410 415
 Glu Cys Cys Leu Ser Gly Asp Gly Met Arg Val Ala Thr Gly Ser Tyr
 420 425 430
 Ser Asn Leu Phe Arg Val Phe Gly Ala Ala Thr Gly Ser Glu Glu Ala
 435 440 445
 Ser Thr Leu Glu Ala Ser Lys Thr Pro Asn Arg Arg Ile Val Thr Pro
 450 455 460

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Pro Ser Lys Ala Gly Ser Arg Leu Ala Asn Leu Ala Arg Gly Arg Arg
465 470 475 480

Asp Asn Arg Arg Gly Gly Glu Ser Pro Gly Ile Asp Leu Asn Gly Gly
485 490 495

Val Gln Asp Phe Thr Ser Lys Leu Leu His Leu Ala Trp His Pro Ala
500 505 510

Ala Asn Val Ile Ala Phe Ala Leu Ala Arg Cys Ser Leu His Pro Thr
515 520 525

Ala Cys Thr Cys
530

<210> 13

<211> 306

<212> PRT

<213> *Physcomitrella patens*

<400> 13

Met Pro Ser Tyr Ala Asp Val Asp Arg Gln Ile Glu Gln Leu Ser Glu
1 5 10 15

Cys Lys Pro Leu Ser Glu Leu Glu Val Lys Asn Leu Cys Asp Gln Ala
20 25 30

Arg Thr Ile Leu Val Glu Glu Trp Asn Val Gln Pro Val Lys Cys Pro
35 40 45

Val Thr Val Cys Gly Asp Ile His Gly Gln Phe His Asp Leu Ile Glu
50 55 60

Leu Phe Arg Ile Gly Gly Lys Ala Pro Asp Thr Asn Tyr Leu Phe Met
65 70 75 80

Gly Asp Tyr Val Asp Arg Gly Tyr Tyr Ser Val Glu Thr Val Ser Leu
85 90 95

Leu Val Ala Leu Lys Val Arg Tyr Arg Asp Arg Ile Thr Ile Leu Arg
100 105 110

Gly Asn His Glu Ser Arg Gln Ile Thr Gln Val Tyr Gly Phe Tyr Asp
115 120 125

Glu Cys Leu Arg Lys Tyr Gly Asn Ala Asn Val Trp Lys Tyr Phe Thr
130 135 140

Asp Leu Phe Asp Tyr Leu Pro Leu Thr Ala Leu Ile Glu His Glu Ile
145 150 155 160

Phe Cys Leu His Gly Gly Leu Ser Pro Ser Leu Asp Thr Leu Asp His
165 170 175

Ile Arg Ala Leu Asp Arg Ile Gln Glu Val Pro His Glu Gly Pro Met
180 185 190

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Cys Asp Leu Leu Trp Ser Asp Pro Asp Asp Arg Cys Gly Trp Gly Ile
195 200 205

Ser Pro Arg Gly Ala Gly Tyr Thr Phe Gly Gln Asp Ile Ala Glu Gln
210 215 220

Phe Asn His Thr Asn Gly Leu Ser Leu Val Ala Arg Ala His Gln Leu
225 230 235 240

Val Met Glu Gly Tyr Asn Trp Cys Gln Asp Lys Asn Val Val Thr Val
245 250 255

Phe Ser Ala Pro Asn Tyr Cys Tyr Arg Cys Gly Asn Met Ala Ala Ile
260 265 270

Met Glu Ile Asp Glu Thr Met Asn Arg Ser Phe Leu Gln Phe Glu Pro
275 280 285

Ala Pro Arg Gln Ser Glu Pro Asp Val Thr Arg Lys Thr Pro Asp Tyr
290 295 300

Phe Leu
305

<210> 14
<211> 353
<212> PRT
<213> Physcomitrella patens

<400> 14
Met Gly Ile Tyr Leu Cys Ser Pro Lys Thr Asp Lys Thr Ser Glu Asp
1 5 10 15

Asp Glu Asn Ala Glu Leu Arg Tyr Gly Leu Ser Ala Met Gln Gly Trp
20 25 30

Arg Asp Ser Met Glu Asp Ala His Lys Ala Ile Leu Asn Val Asp Lys
35 40 45

Asn Thr Ser Thr Ser Ile Phe Gly Ile Phe Asp Gly His Gly Gly Lys
50 55 60

Leu Val Ala Lys Phe Cys Ala Lys His Leu His Gln Glu Val Leu Lys
65 70 75 80

Ser Glu Ala Tyr Ala Lys Gly Asp Leu Lys Ala Ser Leu Glu Tyr Ser
85 90 95

Phe Leu Arg Met Asp Glu Met Met Lys Gly Ala Ser Gly Trp Lys Glu
100 105 110

Leu Gln Ser Leu Glu Glu Thr Ser Ser Gln Leu Asp Lys Leu Gly Asn
115 120 125

Gly Asn Ser Ser Ser Asn Ala Arg Glu Asp Asp Glu Ser Asp Tyr Ser
130 135 140

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Tyr Ala Val Leu Thr Glu Ser Asn Asp Ser Asn Leu Ala Thr Lys Lys
 145 150 155 160
 His Lys Tyr Ser Asp Phe Gln Gly Pro Ile Tyr Gly Ser Thr Ala Val
 165 170 175
 Val Ala Leu Ile Arg Gly Asn Lys Leu Phe Val Ala Asn Ala Gly Asp
 180 185 190
 Ser Arg Cys Ile Met Ser Arg Arg Gly Glu Ala Val Asn Leu Ser Ile
 195 200 205
 Asp His Lys Pro Asn Leu Glu His Glu Arg Lys Arg Ile Glu Ser Ala
 210 215 220
 Gly Gly Phe Val His Gly Gly Arg Val Asn Gly Ser Leu Asn Leu Thr
 225 230 235 240
 Arg Ala Ile Gly Asp Met Glu Phe Lys Gly Arg Pro Asp Leu Pro Pro
 245 250 255
 Asp Lys Gln Val Val Thr Cys Cys Pro Asp Val Val Glu Val Asp Leu
 260 265 270
 Gly Pro Gly Asp Glu Phe Ile Val Leu Ala Cys Asp Gly Ile Trp Asp
 275 280 285
 Val Met Ser Ser Gln Ala Val Val Asp Phe Val Lys Ser Arg Leu Pro
 290 295 300
 Thr Thr Lys Thr Leu Ser Ser Leu Cys Glu Glu Ile Leu Asp Tyr Cys
 305 310 315 320
 Leu Ser Pro Thr Thr Arg Gln Gln Glu Gly Cys Asp Asn Met Ser Ile
 325 330 335
 Ile Ile Val Gln Pro Lys Gln Ser Gly Val Ala Ala Ser Ser Ser Thr
 340 345 350

Asp

<210> 15
 <211> 371
 <212> PRT
 <213> Physcomitrella patens

<400> 15
 Met Val Glu Trp Val Met Lys Met Leu Met Ala Cys Trp Arg Pro Val
 1 5 10 15
 Gln Lys Tyr Thr His Leu Gly Glu Glu Asn Gly Asp Asn His Asp Pro
 20 25 30
 Leu Leu Trp His Lys Asp Leu Gly Asp His Ala Ala Gly Gln Phe Ser
 35 40 45

Ile Ala Ala Val Gln Ala Asn Ala Ile Leu Glu Asp Met Val Gln Val
 50 55 60
 Glu Thr Gly Pro Phe Gly Thr Phe Val Gly Val Tyr Asp Gly His Gly
 65 70 75 80
 Gly Pro Glu Ala Ser Arg Tyr Val Asn Asp Ser Leu Tyr Arg His Leu
 85 90 95
 Gln Lys Phe Ala Thr Gln His Gly Gly Met Ser Ser Glu Val Leu Gln
 100 105 110
 Gln Ala Phe Lys Gln Thr Glu Glu Gly Phe Leu Glu Ile Val Arg Asp
 115 120 125
 Ser Trp Leu Thr Lys Pro Gln Ile Ala Ala Val Gly Ser Cys Cys Leu
 130 135 140
 Val Gly Val Val Trp Glu Cys Lys Leu Tyr Ile Ala Ser Leu Gly Asp
 145 150 155 160
 Ser Lys Ala Val Leu Gly Arg Phe Ser Arg Asn Leu Gln Ser Val Ile
 165 170 175
 Ala Thr Glu Ile Ser Thr Glu His Asn Ala Ser Val Glu Ala Val Arg
 180 185 190
 Gln Asp Leu Gln Ala Ala His Pro Asp Asp Pro Arg Ile Val Val Leu
 195 200 205
 Arg His Gly Val Trp Arg Val Lys Gly Leu Ile Gln Val Ser Arg Ser
 210 215 220
 Ile Gly Asp Val Tyr Leu Lys Lys Ala Glu Phe Asn Arg Glu Pro Leu
 225 230 235 240
 Ile Gly Arg Phe Arg Leu Pro Glu Pro Leu Gln Arg Pro Val Met Ser
 245 250 255
 Ala Glu Pro Asp Ile Arg Val Ile Asp Leu Thr Pro Asp Val Glu Phe
 260 265 270
 Val Ile Phe Ala Ser Asp Gly Leu Trp Glu His Leu Ser Asn Gln Glu
 275 280 285
 Ala Val Asp Ile Val His Lys Tyr Pro Arg Ala Gly Ile Ala Arg Gln
 290 295 300
 Leu Ile Arg Tyr Ala Leu His Glu Ala Ala Lys Lys Arg Glu Met Arg
 305 310 315 320
 Tyr Ser Asp Leu Lys Lys Ile Glu Arg Gly Ile Arg Arg His Phe His
 325 330 335
 Asp Asp Ile Thr Val Val Val Val Phe Leu Asp His Asn Leu Val Ser
 340 345 350

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Asn Gly Ser Gly Ile Ser His His Ile Ser Val Lys Gly Gly Val Asp
355 360 365

Lys Pro Ser
370

<210> 16
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 16
caggaaacag ctatgacc

18

<210> 17
<211> 19
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 17
ctaaagggaa caaaagctg

19

<210> 18
<211> 18
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 18
tgtaaaacga cggccagt

18

<210> 19
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 19
ctgccgttgg aggcatactc gccatc

26

<210> 20
<211> 34
<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 20

atccccgggca tcgggaagac ggtgtgtgtg tgtg

34

<210> 21

<211> 34

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 21

gcgttaacgc taccagctc gggctgaacc agtc

34

<210> 22

<211> 25

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 22

ggagcccttg ctgctactgt atgct

25

<210> 23

<211> 32

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 23

atccccgggtg gtggtggcgg tgaagttatt ac

32

<210> 24

<211> 31

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 24

gcgttaacat gtacaagctg ttggatgcag c

31

<210> 25

<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 25
acatcggggcc ctogtgcggc acttc

25

<210> 26
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 26
gcgttaacgc gcggaggaga gcggatcggt tag

33

<210> 27
<211> 33
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 27
gcgagctcga gcatgccata tacagtaggt gtg

33

<210> 28
<211> 34
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 28
gcgatatcga ttgcaaggg cgaagtgcac aaga

34

<210> 29
<211> 32
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 29
gcgatatcga aggcagaagg caactcccag tt

32

<210> 30
 <211> 26
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence: Primer

<400> 30
 cactcccaca ccacacctac caggca

26

<210> 31
 <211> 25
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence: Primer

<400> 31
 gggcttcgtg agccatgaat ccctt

25

<210> 32
 <211> 34
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence: Primer

<400> 32
 atccccgggcg tggaaggaga ggcgaatgtg gagg

34

<210> 33
 <211> 32
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence: Primer

<400> 33
 gcgagctcct gtgggtgtct agcttcaggt tc

32

<210> 34
 <211> 30
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence: Primer

<400> 34

gcgctgcaga tttcatttgg agaggacacg

30

<210> 35

<211> 35

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 35

cgcggccggc ctcagaagaa ctcgtcaaga aggcg

35

<210> 36

<211> 25

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 36

gctgacacgc caagcctcgc tagtc

25

<210> 37

<211> 25

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 37

gcagacgtat gggaactagc cacct

25

<210> 38

<211> 26

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 38

cgctctacga ttcggtagggt gagagc

26

<210> 39

<211> 25

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 39
ctggcgacag aggaggacgc gttgt

25

<210> 40
<211> 26
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 40
gcgtaggctc ttctacatct cgcaac

26

<210> 41
<211> 27
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 41
cggacgatct tggaggagga gtggaac

27

<210> 42
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 42
gtgtcgagcg atggagacag accac

25

<210> 43
<211> 25
<212> DNA
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence: Primer

<400> 43
cggatggatg agatgatgaa gggag

25

<210> 44
<211> 26
<212> DNA
<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 44

cacgaccacc atggacgaag cctcca

26

<210> 45

<211> 26

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 45

ggctgtgctc ggtagattct ctgcga

26

<210> 46

<211> 25

<212> DNA

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence: Primer

<400> 46

cagcctcttg gttggacaag tgctc

25